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**Robertsson et al.**

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(54) **METHOD OF MOORING A SHIP AND ARRANGEMENT TO ACCOMPLISH THE METHOD**

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(56) **References Cited**

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U.S. PATENT DOCUMENTS

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3,902,447 A \* 9/1975 Slocum ..... B63B 21/50  
114/230.26  
5,381,750 A \* 1/1995 Pollack ..... B63B 21/507  
114/230.12

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(Continued)

FOREIGN PATENT DOCUMENTS

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MC WO 2012032163 A1 \* 3/2012 ..... B63B 21/508  
NO WO 9938763 A1 \* 8/1999 ..... B63B 21/507

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OTHER PUBLICATIONS

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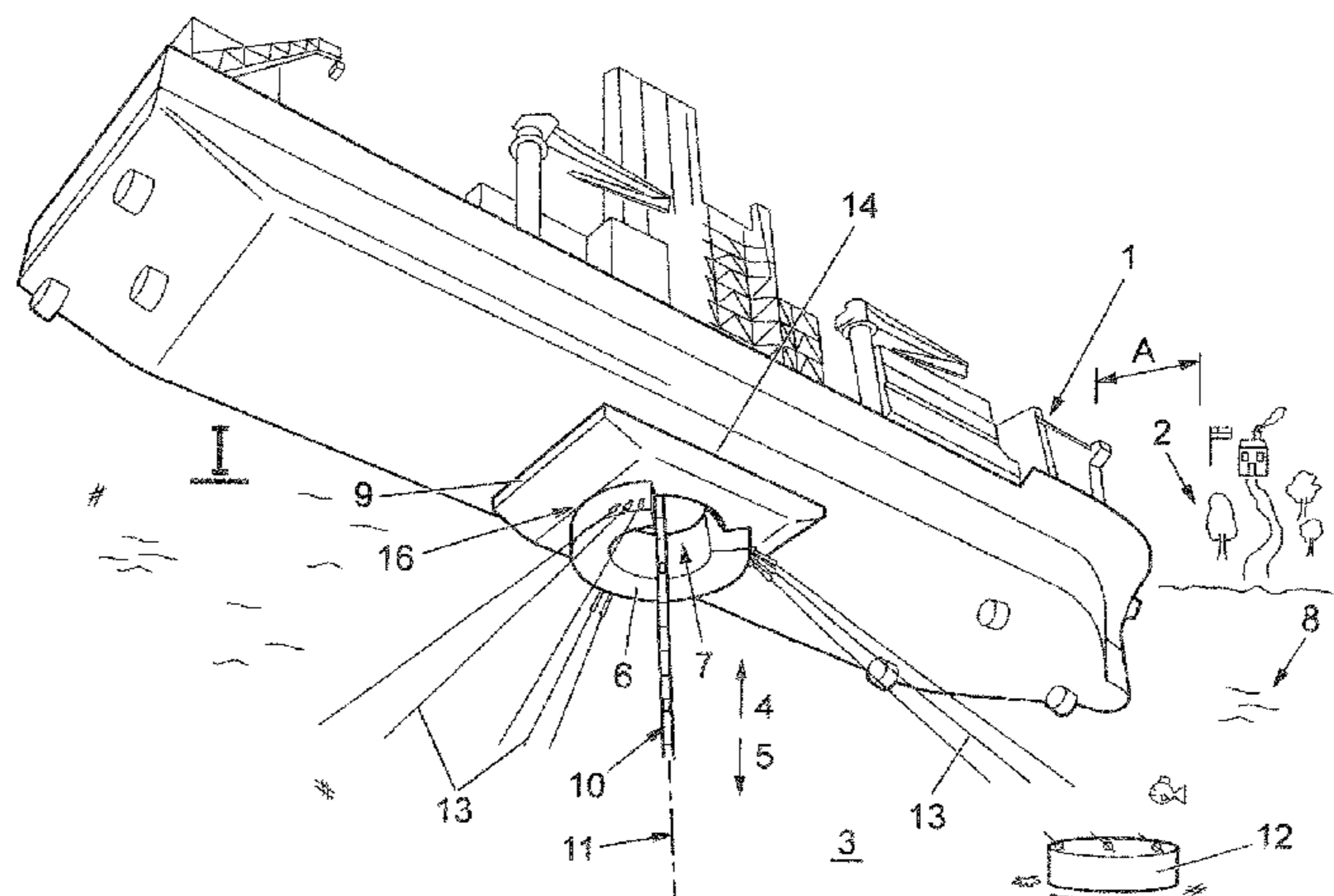
(57) **ABSTRACT**

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Methods and arrangements of releasably mooring a ship in a definite position at a distance from land with an ability to return later to the same place. The mooring is accomplished by means of a substantially ring-shaped mooring unit, which can be raised and lowered and which has a gap along its periphery, which can be connected to and disconnected from the ship by a connectable part located below the surface of the water. The mooring unit enables a ship carrying a downwardly protruding load to pass by after disconnection and lowering of the mooring unit, and to be rotated round an essentially vertical imaginary axis.

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**B63B 21/50** (2006.01)  
**B63B 3/14** (2006.01)  
(52) **U.S. Cl.**  
CPC ..... **B63B 22/02** (2013.01); **B63B 21/50** (2013.01); **B63B 21/508** (2013.01); **B63B 2003/147** (2013.01); **B63B 2022/028** (2013.01)

**12 Claims, 7 Drawing Sheets**



(56)

**References Cited**

2015/0210361 A1\* 7/2015 Robertsson ..... B63B 21/508  
441/3

U.S. PATENT DOCUMENTS

7,513,208 B1\* 4/2009 Seaman ..... B63B 21/508  
114/230.12  
9,315,242 B2\* 4/2016 Veselis ..... B63B 22/02  
2011/0130057 A1\* 6/2011 Denise ..... B63B 21/508  
441/5  
2013/0183876 A1\* 7/2013 Veselis ..... B63B 22/02  
441/3

FOREIGN PATENT DOCUMENTS

WO 99/38763 A1 8/1999  
WO 2011/047736 A1 4/2011  
WO 2012/032163 A1 3/2012

\* cited by examiner



FIG. 2

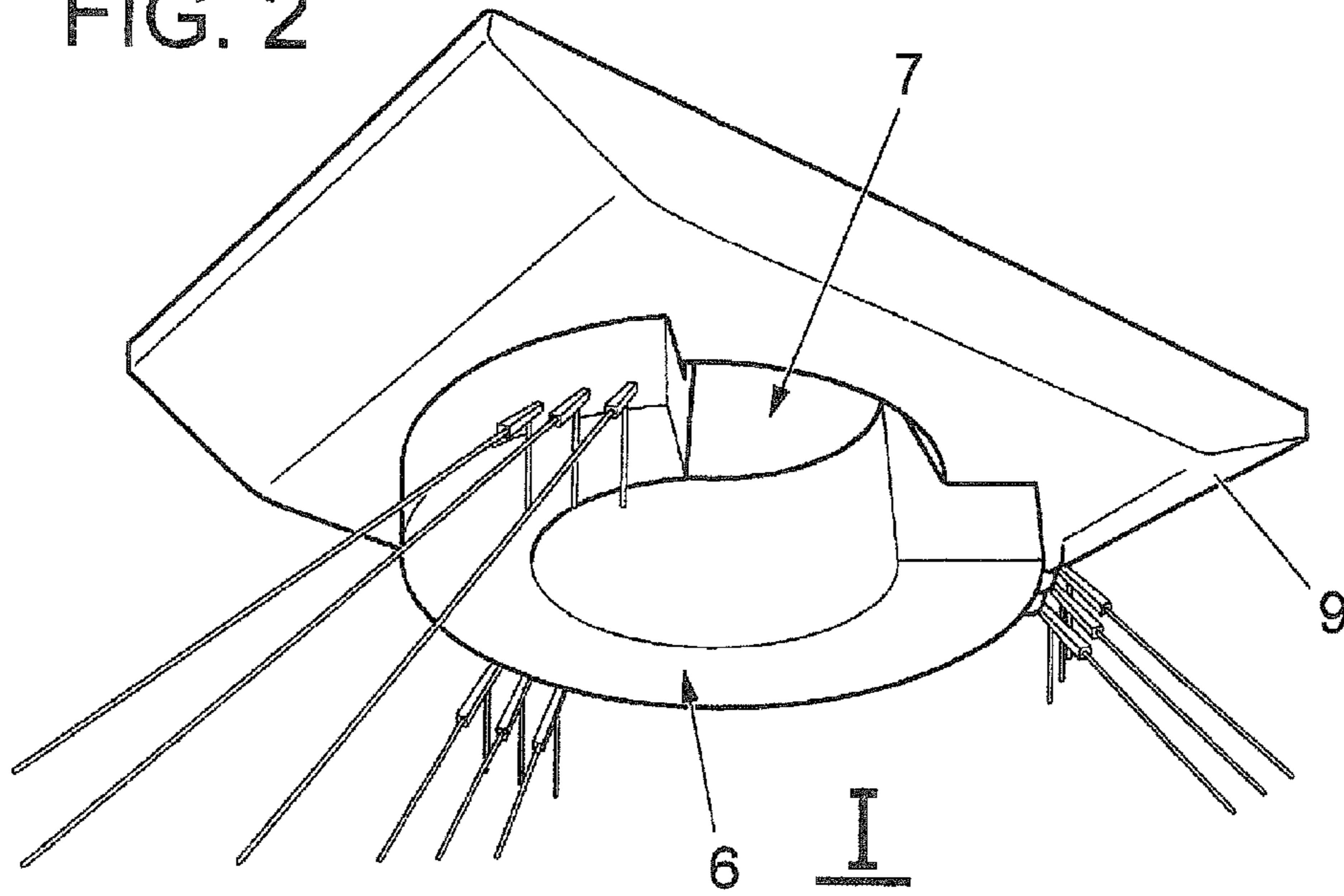
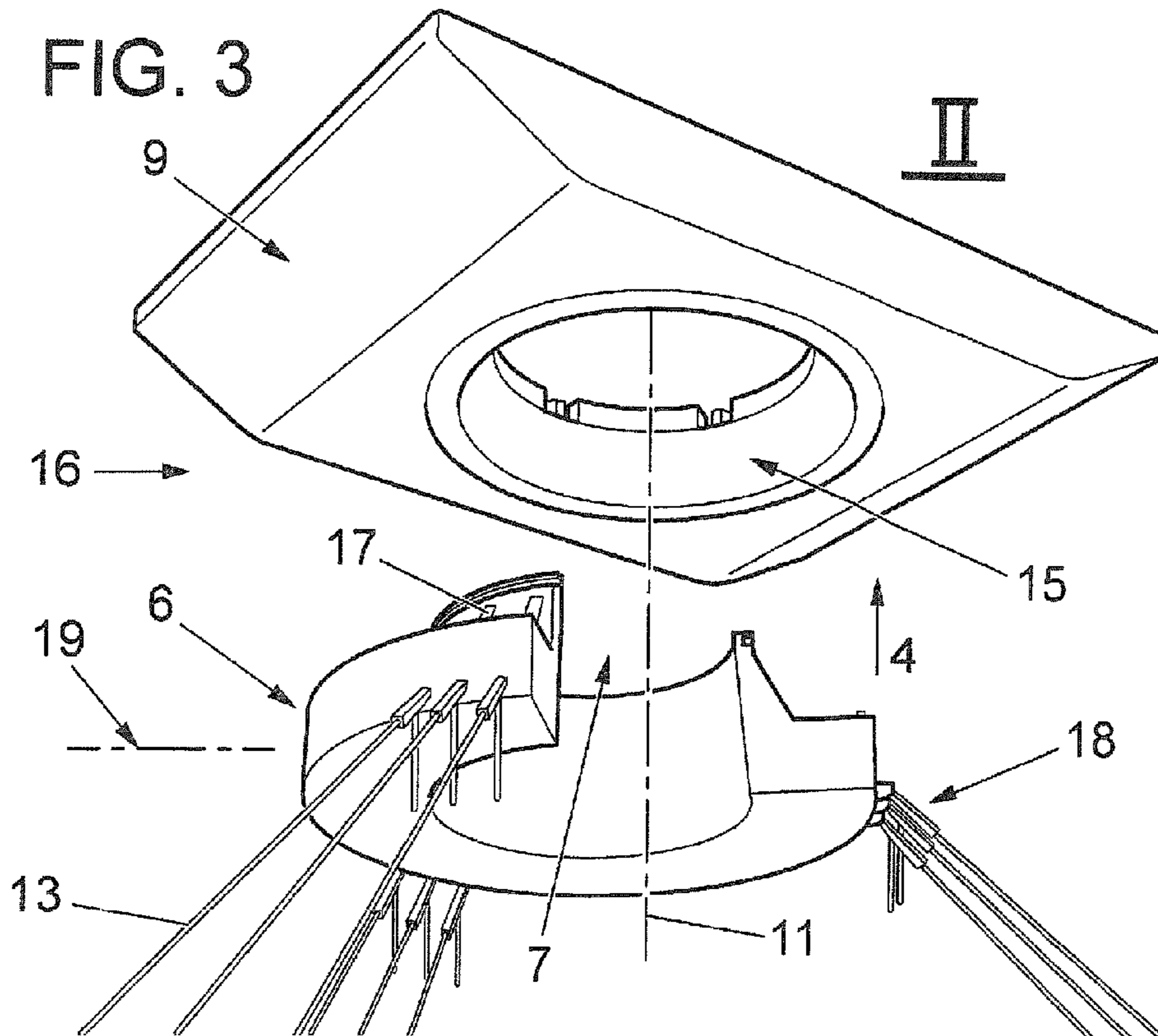


FIG. 3



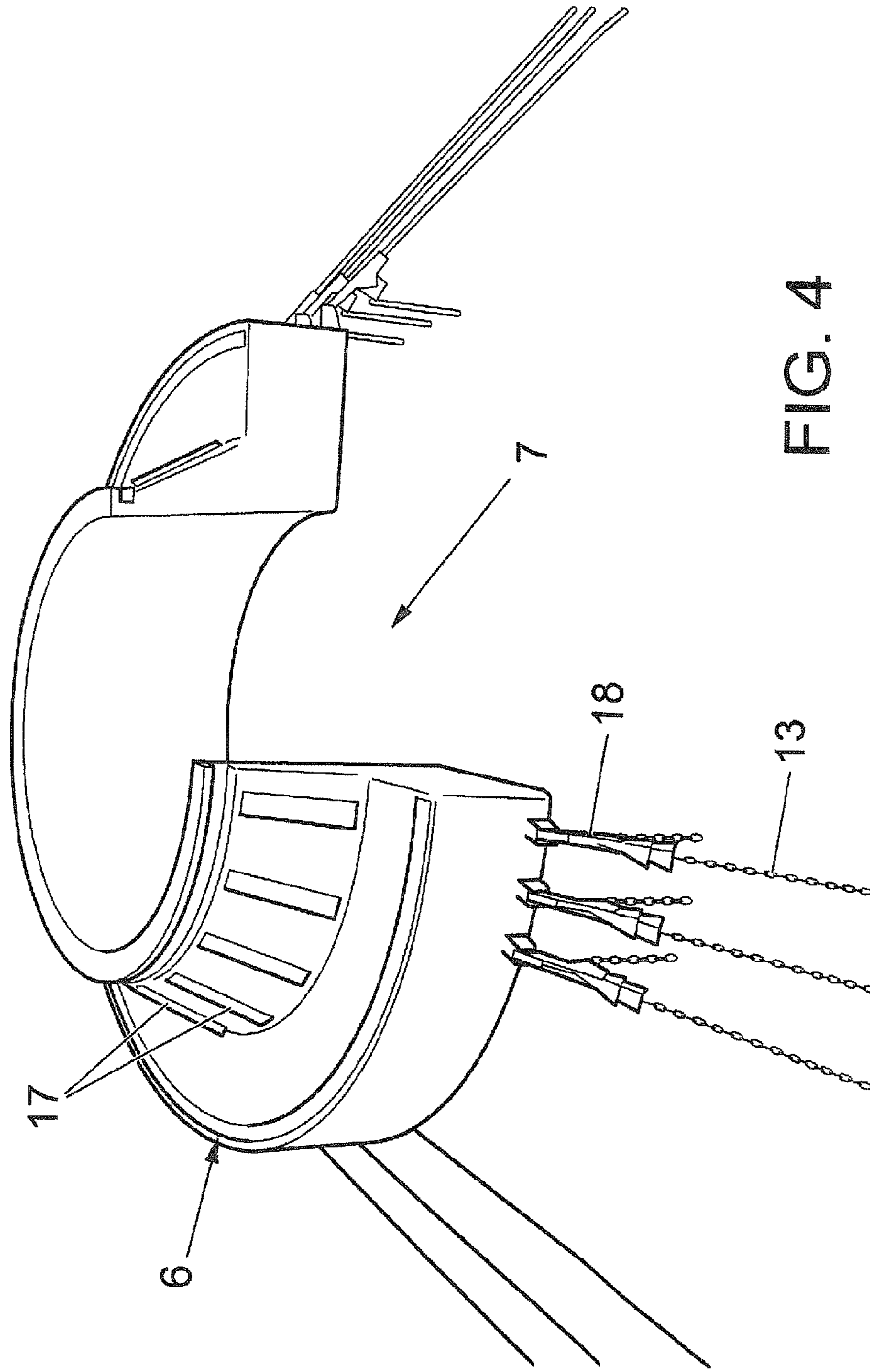


FIG. 4

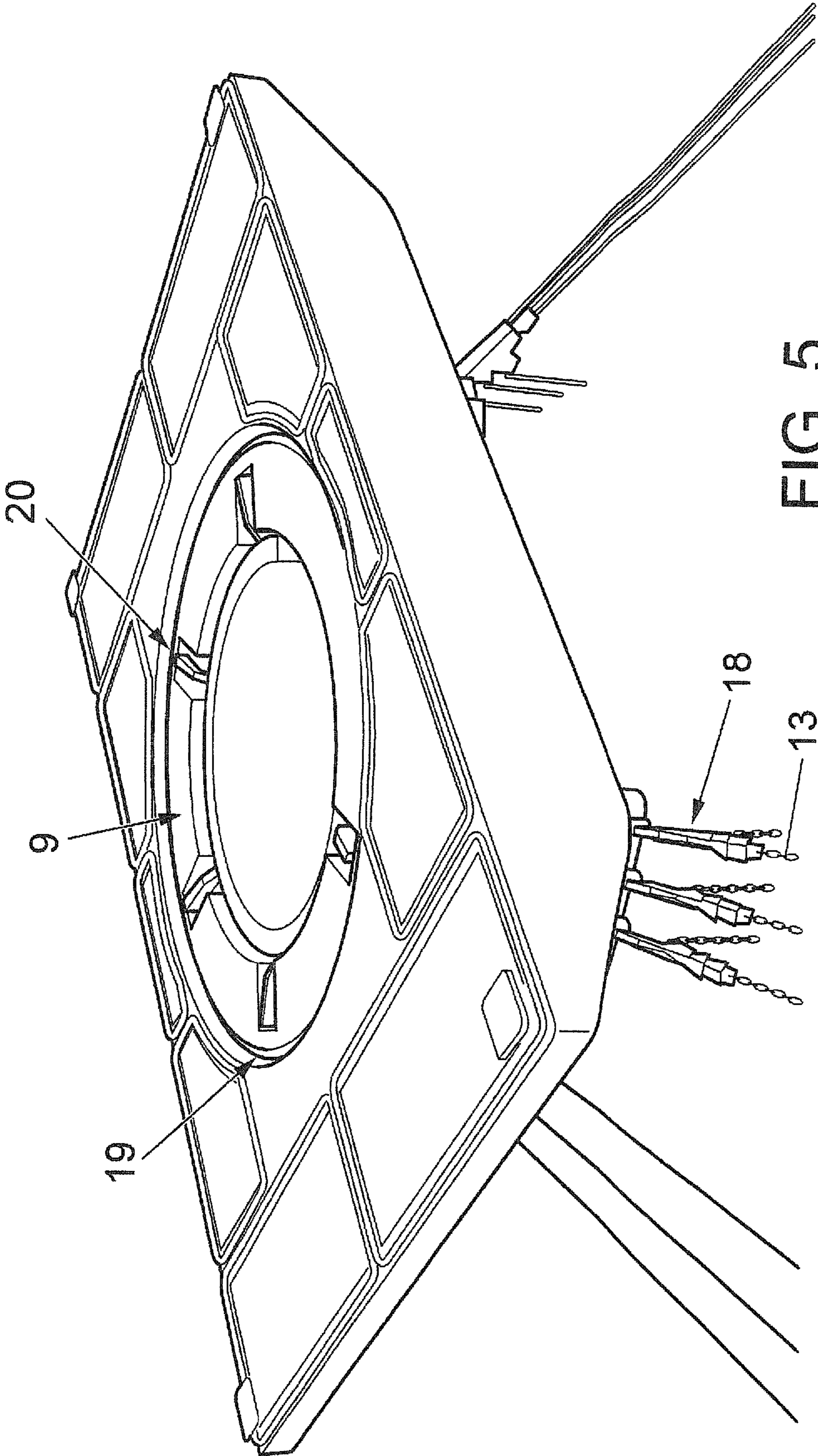
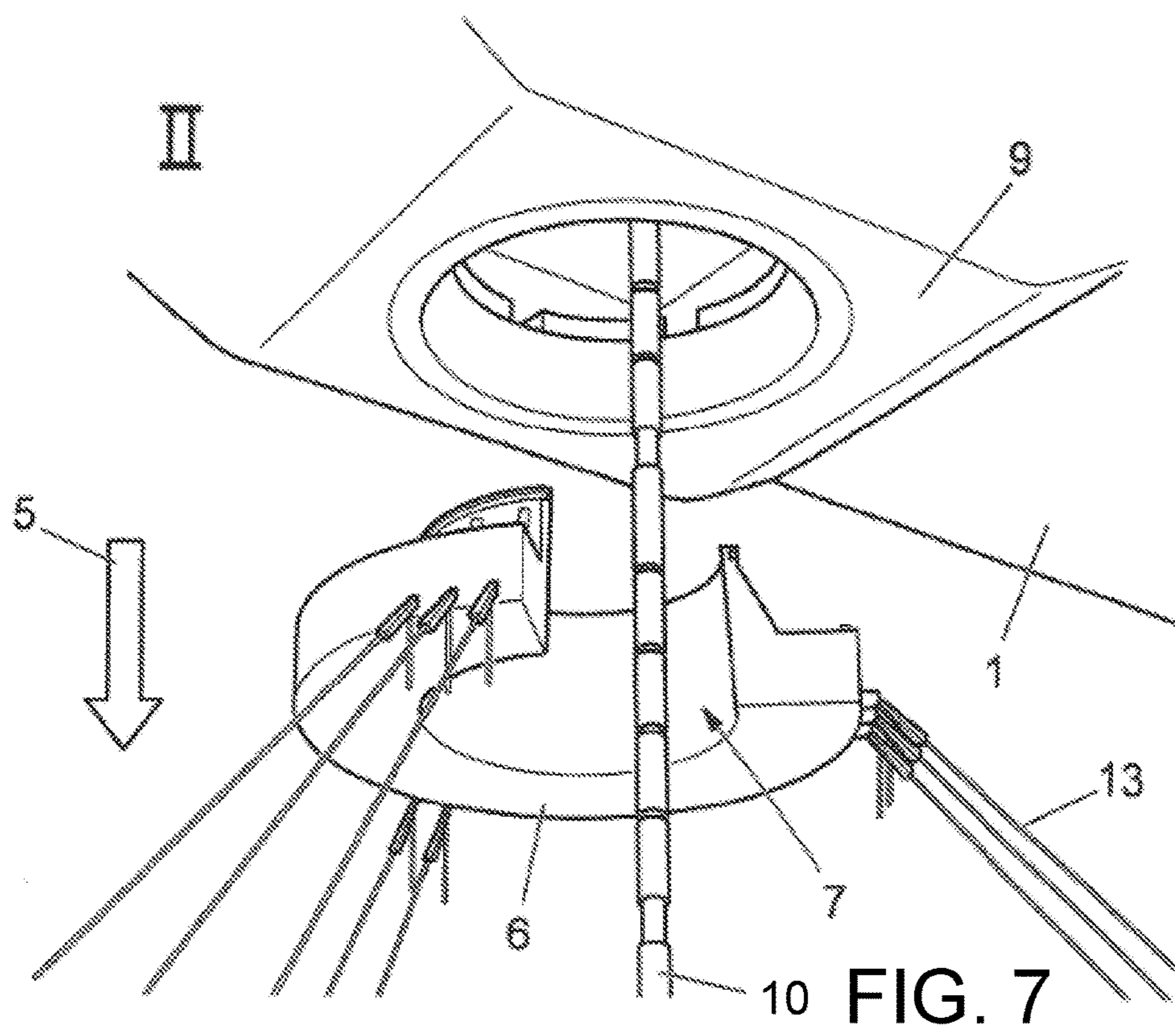
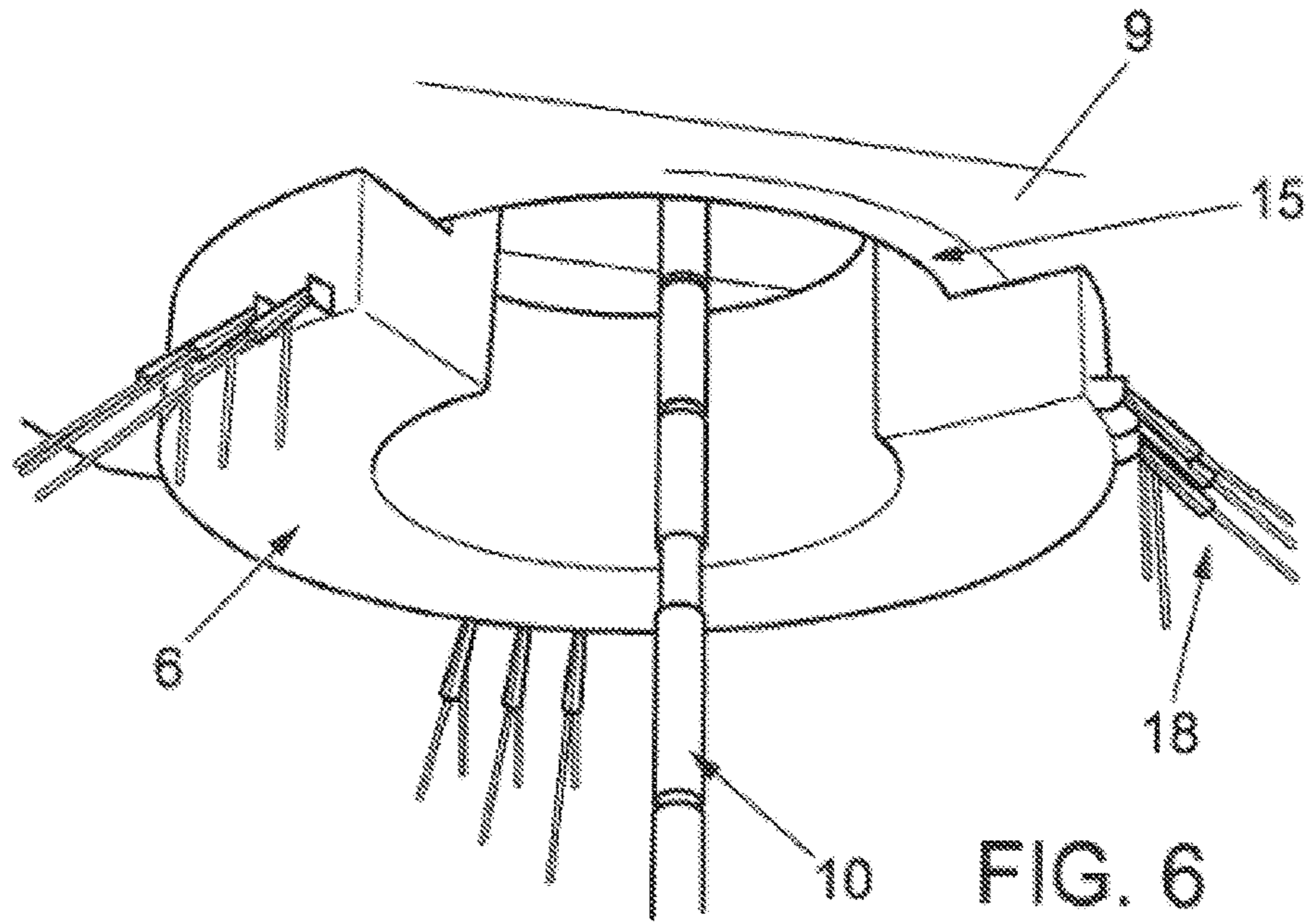


FIG. 5



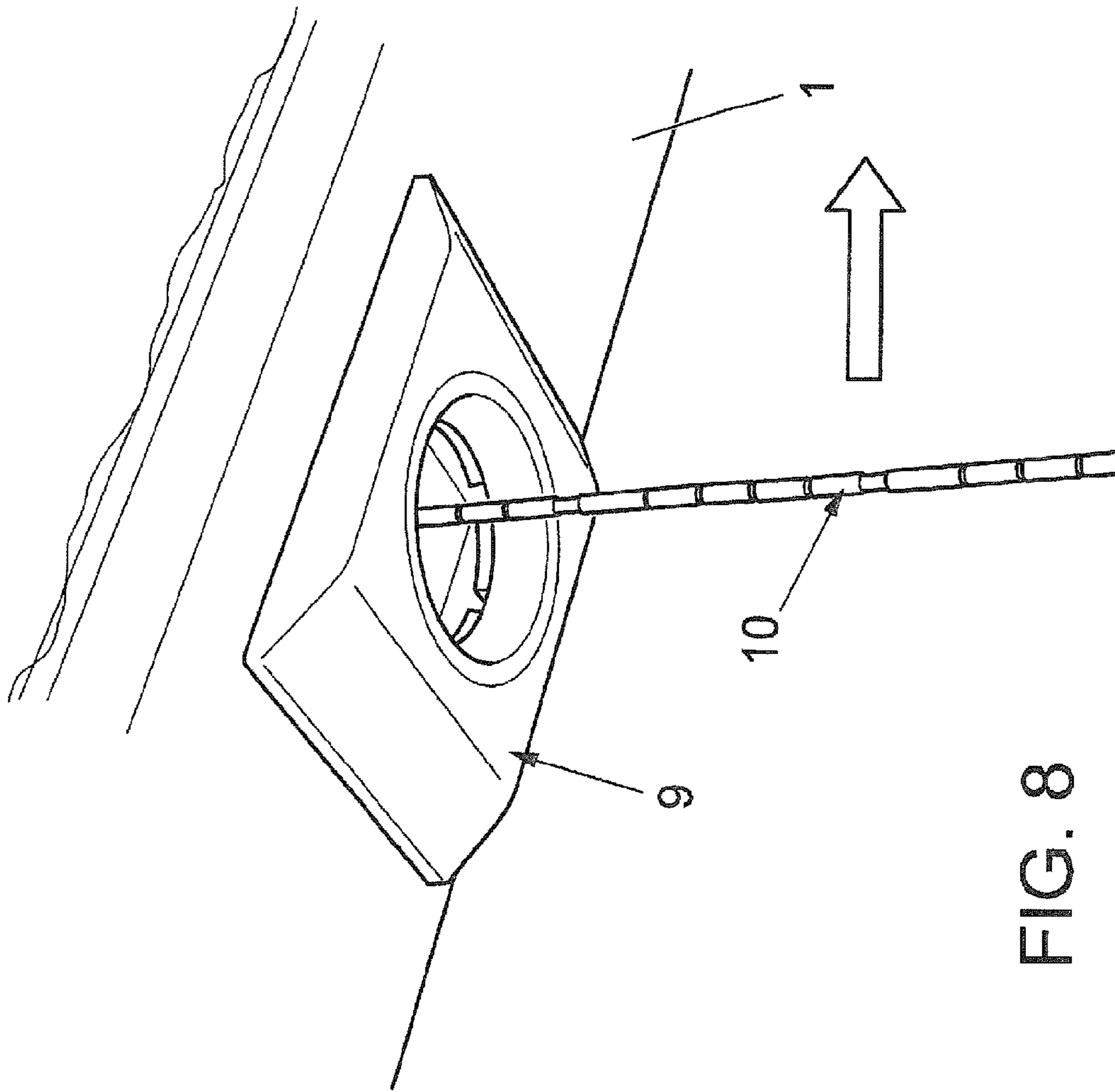
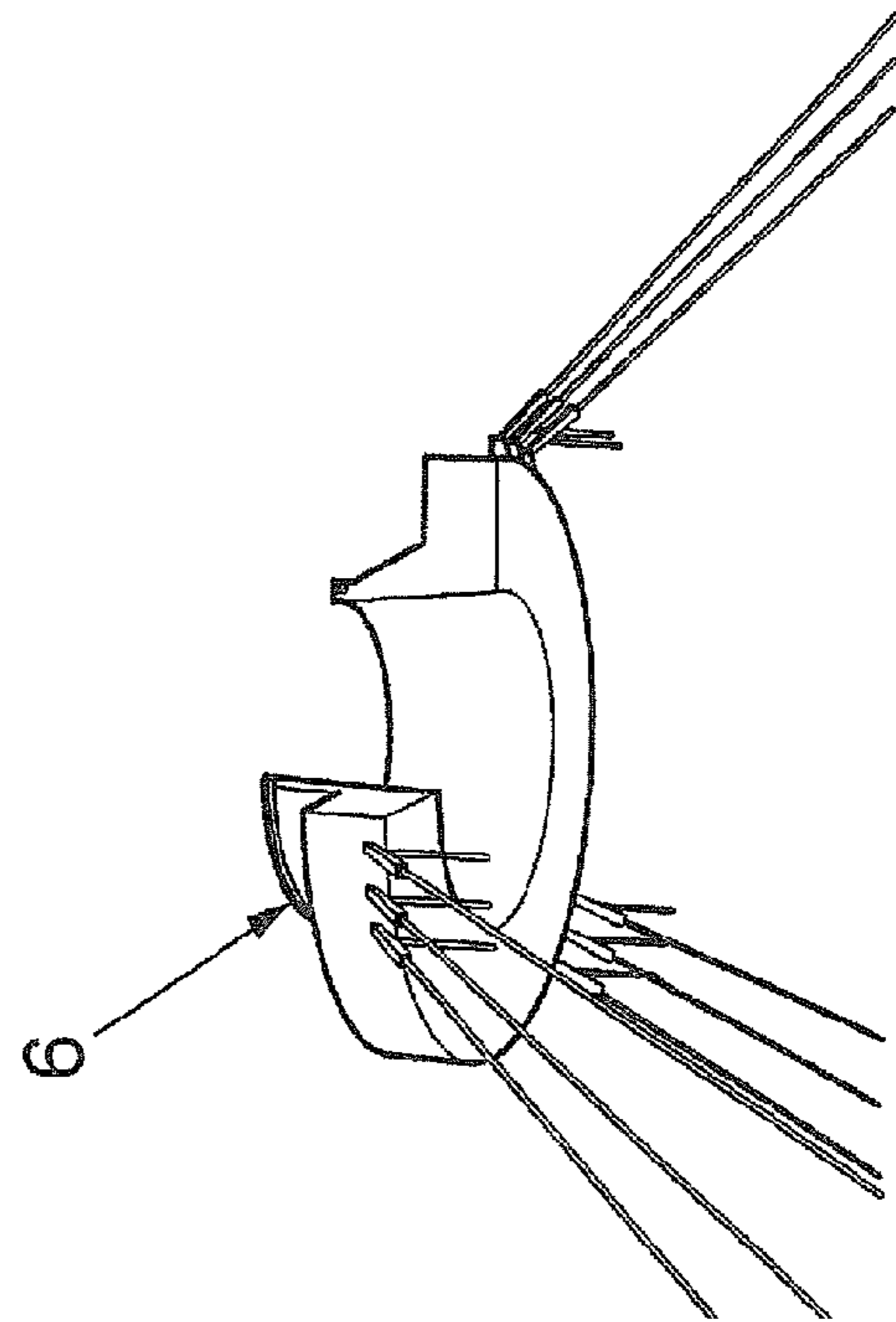
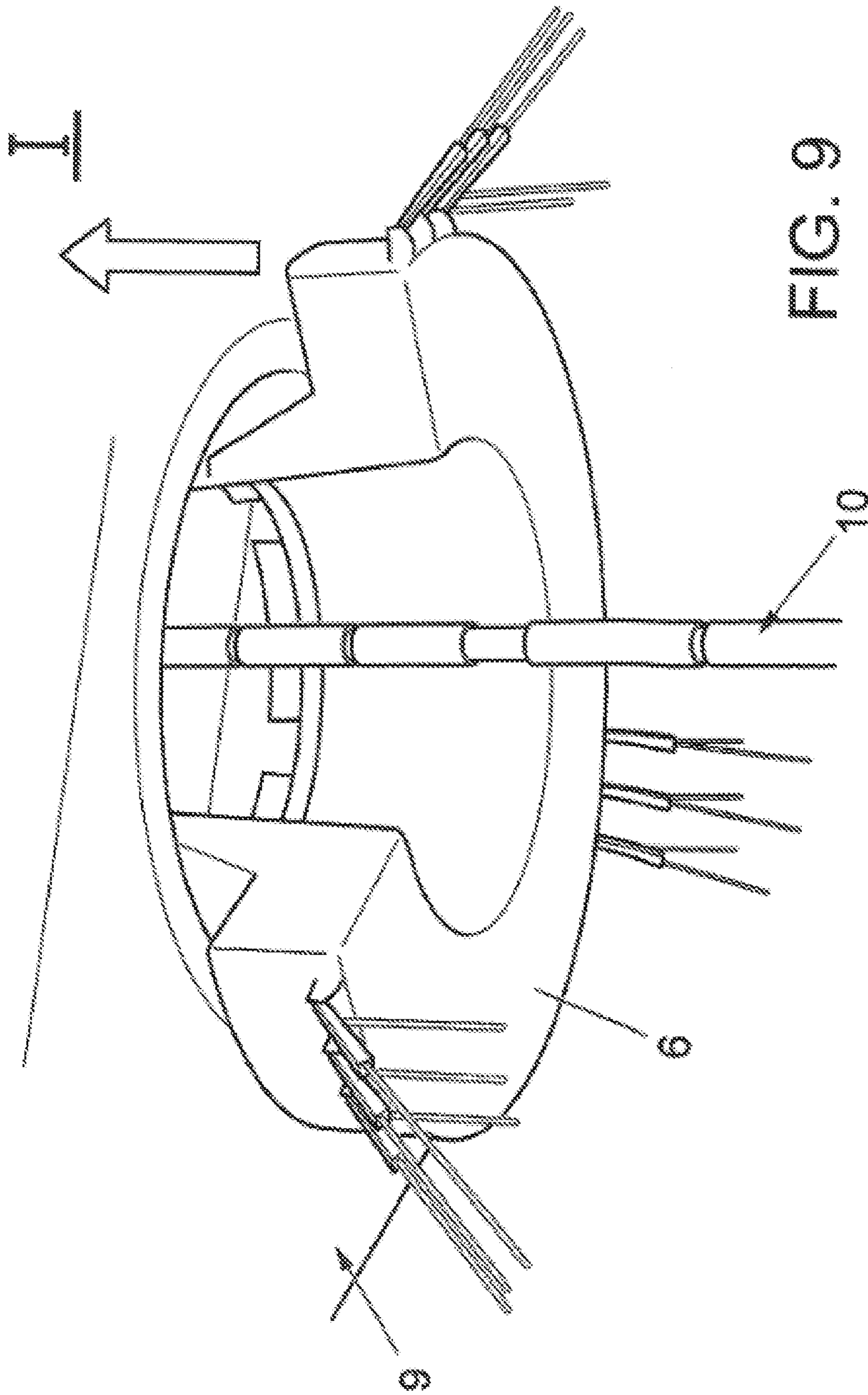


FIG. 8







## 1

**METHOD OF MOORING A SHIP AND  
ARRANGEMENT TO ACCOMPLISH THE  
METHOD**

The present invention relates to a method of accomplish-  
ing mooring of ship in a definite position at a distance from  
land and with possibility to make the ship leave its moorage  
in question.

For floating vessels Dynamic Positioning (DP) and/or  
mooring systems are used in order to prevent the vessel from  
moving, i.e. to keep it in a definite position. Depending on  
the assignment of the ship and the water depth in question,  
various demands are made as to the immobility of the ship  
or, inversely, demands on the maximum allowed deviation  
from the definite position.

The capability of the ship of keeping the definite position  
depends on the reaction time of the DP-system to counteract  
the environmental forces arising from wind, waves and  
currents. In certain waters the ship might also be affected by  
forces caused by drift ice. The DP-system consists of  
thrusters, i.e. propulsors which can be rotated 360 degrees in  
the horizontal plane, and one or several reference systems  
for definition of the definite position. The thrusters generate  
a resulting force, which counteracts the environmental  
forces, so that the definite position of the ship is maintained.

In certain operation areas there might be restrictions  
concerning emissions. Reduction of the power necessary to  
keep the ship in the definite position increases the availabil-  
ity by reduced emissions.

A complication when mooring of for example ships  
adapted to drill into the sea bed is that certain situations  
might require that the ship in question can be disconnected  
in a controlled way at relatively short notice and leave the  
definite position, and after some time can be connected to  
the mooring system again.

A further complication is that during certain operations a  
steel pipe, a so called "riser", is used between a valve at the  
sea bed and the ship. To take up the "riser" before it is  
disconnected is too time-consuming, why it is necessary to  
design the arrangement so that disconnection can be effected  
without it being necessary to take up the "riser" to the ship.

The main object of the present invention is, therefore, in  
the first place to solve among other things said problems in  
an effective way by means of simple and well working  
means.

Said object is reached by means of a method according to  
the way indicated, which is mainly characterized in that the  
mooring is accomplished by means of a substantially ring-  
shaped mooring unit, which can be raised and lowered and  
which has a gap along the periphery, and which can be  
connected to and disconnected from the ship, respectively,  
by means of a connectable part located below the surface of  
the water, and which mooring unit makes it possible for the  
ship, with downwards protruding load supported by the ship,  
to pass by after disconnection and lowering of said mooring  
unit and to be rotated round an essentially vertical imaginary  
axis.

A further problem with the invention is to find means,  
which can be applied effectively and safely when carrying  
out a method according to the invention.

Said means are included by an arrangement, which is  
mainly characterized in that a substantially ring-shaped  
mooring unit, which can be raised and lowered and which  
has a gap along the periphery, is provided with means so that  
it can be releasably connected to and disconnected from the  
ship in question, respectively, below the surface of the water,

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and so it can be rotated in relation to the ship round an  
essentially vertical imaginary axis.

The invention is described in the following with reference  
to the accompanying drawings, in which

FIG. 1 is a perspective view of the invention in active state  
connected to the underside of the hull of a ship,

FIGS. 2-3 illustrate the invention in connected and dis-  
connected state, respectively, seen obliquely from below,

FIG. 4 is a perspective view obliquely from above of a  
disconnected mooring unit,

FIG. 5 is a perspective view obliquely from above of a  
connectable part, which is disconnected from a ship, and  
with a mooring unit connected to said part,

FIGS. 6-8 illustrate various stages from a connected state  
to a state, in which said mooring unit and the part, which can  
be connected to a ship, are separated from each other, and

FIG. 9 illustrates a state, in which the connectable moor-  
ing unit and the connectable part, which can be connected to  
a ship, can be reconnected to a ship.

A method of accomplishing safe mooring of a ship 1 in a  
definite position at a distance from land 2 and with possi-  
bility to make the ship 1 in question leave the moorage 3 in  
question for the ship 1 means that the mooring is accom-  
plished by means of a mooring unit 6, which can be raised  
4 and lowered 5 and which has a gap 7 seen along its  
periphery. Further, said mooring unit 6 is so constituted, that  
it can be connected to I and disconnected from II the ship 1,  
respectively, by means of a connectable part 9 located below  
the surface of the water 8. Said mooring unit 6 makes it  
possible for the ship 1, with downwards protruding load 10  
supported by the ship, to pass by said mooring unit 6 after  
disconnection and lowering of said mooring unit 6, and said  
unit can rotate in relation to the ship 1 round an essentially  
vertical imaginary axis 11.

According to the invention said mooring unit 6 is remote-  
controlled in order to accomplish the desired raising and  
lowering 4, 5 thereof, and the mooring is accomplished by  
means of chains 13 or other pulling elements, which are  
connected to a part 12 anchored in the bottom of the sea.  
Further, said mooring unit 6, which can be raised and  
lowered by buoyancy, is releasably connected from below  
the ship 1 to the moon pool 14 of the ship 1 in question, i.e.  
an opening of the ship located below the surface of the  
water, or to another part of the ship 1. Preferably, fastening  
means 19, 20 are used, which operate with vacuum and  
excess of displacement. A rotatory bearing 15 adapted to  
connected mooring unit 6 is received by the connectable part  
9.

An arrangement 16 for carrying out a method of accom-  
plishing mooring of a ship 1 in a definite position at a  
distance A from land 2, and with possibility to make the ship  
1 leave the moorage in question of the ship 1, comprises an  
essentially ring-shaped mooring unit 6, which can be raised  
and lowered 4, 5 and which has a gap 7 along the periphery,  
and which exhibits means 19, 20 so that it can be releasably  
connected to and disconnected from the ship 1 in question,  
respectively, below the surface of the water 8, and so it can  
be rotated in relation to the ship 1 round an essentially  
vertically directed imaginary axis 11. Said mooring unit 6 is  
constituted by a horseshoe-shaped body, which has a gap in  
the form of a permanently open opening 7, or an opening,  
which can be closed on desired occasions, and which is  
arranged to have the function of a mooring buoy, which can  
be raised to the desired level 19 in the water. Further, the  
mooring unit 6 is arranged to be connected to a bearing unit  
9, which is supported by the ship 1 below the surface of the  
water 8 and which comprises a rotatory bearing 15 for the

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connectable mooring unit **6**, and whereby locking means **17**, which can be remote-controlled, are arranged to lock the mooring unit **6** to a bearing unit **9**, which can be connected to the ship **1** in question and which can be adjusted itself depending on arising environmental forces. The mooring unit **6** exhibits chains **13** or other pulling elements, which are connected to a part **12** anchored in the bottom of the sea, and a mechanism **18** for said chains **13**, etc., the length of which is adjustable, and said unit is arranged to be anchored with its opening **7** in a definite direction and at the desired level **19** in the water, by means of for instance said chains **13**, etc. The mooring unit **6** has adjustable buoyancy and submerging capacity, respectively, owing to air tank and container therein, which can be filled with liquid, whereby also this function is of use when the level is adjusted, especially when the height of the mooring unit **6** is adjusted.

To sum up, it can be mentioned that the invention makes it possible to moor the ship **1** to the bottom of the sea by means of a separate arrangement **16**. The arrangement is so designed, that the ship can adjust itself to the least possible environmental force, so called "weathervaning". The arrangement has a rotary part in order to make "weathervaning" possible. To this rotary part a buoy **6** supporting the mooring system is connected. When all these parts are connected the ship is moored. In certain situations the arrangement is a complement to the DP-system, in other situations the DP-system is a complement to the mooring system. In order to make disconnection possible when for example the riser **10** is mounted, the buoy **6** is provided with an opening **7** to make it possible to move the ship **1** from the definite position without taking up the riser **10** to the ship **1**.

The nature and the function of the invention should have been clear from the above description and also from the drawings, which illustrate the nature and the function.

Of course, the invention is not limited to the embodiments described above and illustrated in the accompanying drawings. Modifications are possible, especially as far as the nature of the different parts is concerned, or by using equivalent technique, without departing from the scope of the invention as it is defined in the patent claims.

The invention claimed is:

**1.** A method of releasably mooring a water-borne ship at a definite position at a distance from land, comprising:

raising or lowering a substantially ring-shaped mooring unit having a gap in a periphery of the mooring unit, wherein the mooring unit is releasably connected to the ship by a connectable part located below a surface of the water and is rotatable around a substantially vertical

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axis, whereby the mooring unit enables the ship to pass by the mooring unit after the mooring unit is disconnected and lowered when the ship carries a downwardly protruding load.

**2.** The method of claim **1**, wherein the mooring unit is remote-controlled and includes at least one pulling element that is connected to an anchor part anchored below the water.

**3.** The method of claim **2**, wherein raising or lowering the mooring unit comprises changing a buoyancy of the mooring unit, and connecting and disconnecting a rotary bearing of the connectable part to the mooring unit, and the connectable part is fastened to the ship.

**4.** The method of claim **3**, wherein the mooring unit is releasably connected to the connectable part using vacuum.

**5.** An apparatus for carrying out the method of claim **1**, comprising:

a substantially ring-shaped mooring unit, wherein the mooring unit is configured to be raised and lowered, has a gap along a periphery of the mooring unit, and is configured to releasably connect to a connectable part attached to the ship below the surface of the water and to rotate in relation to the ship around the substantially vertical axis.

**6.** The apparatus of claim **5**, wherein the mooring unit includes a body having a closeable gap.

**7.** The apparatus of claim **5**, wherein the mooring unit includes a body that is horseshoe-shaped.

**8.** The apparatus of claim **5**, wherein the mooring unit is configured to connect to a rotary bearing supported by the ship below the surface of the water.

**9.** The apparatus of claim **8**, further comprising a remote-controlled locking device configured to lock the mooring unit to the rotary bearing.

**10.** The apparatus of claim **5**, further comprising at least one pulling element configured to connect to an anchor part anchored below the water, and a mechanism for adjusting a length of the at least one pulling element.

**11.** The apparatus of claim **10**, wherein the mooring unit is configured to connect to the anchor part with the gap disposed in a direction determined by the at least one pulling element.

**12.** The apparatus of claim **5**, wherein a buoyancy of the mooring unit is adjustable by operation of an air tank of the mooring unit, and the mooring unit is configured to submerge by operation of a liquid-fillable tank of the mooring unit.

\* \* \* \* \*